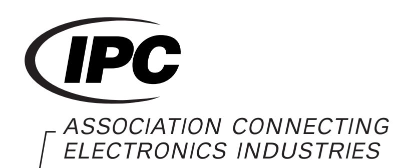


IPC-2513A

Sectional Requirements for Implementation of Drawing Methods for Manufacturing Data Description [DRAWG]

“The data model of this standard shall be in effect until 2001-12.” At that time, the committee will consider changes, revision, other actions.

IPC-2513A

November 2000

A standard developed by IPC

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- Focus on end product performance
- Include a feedback system on use and problems for future improvement

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- Increase time-to-market
- Keep people out
- Increase cycle time
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- Contain anything that cannot be defended with data

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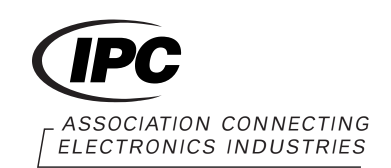
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IPC-2513A



Sectional Requirements for Implementation of Drawing Methods for Manufacturing Data Description

A standard developed by the Computerized Data Format Standardization Subcommittee (2-11) of the Data Generation and Transfer Committee (2-10) of the Institute for Interconnecting and Packaging Electronic Circuits.

The GenCAM format is intended to provide CAD-to-CAM, or CAM-to-CAM data transfer rules and parameters related to manufacturing printed boards and printed board assemblies. The requirements of IPC-2511 are a mandatory part of this sectional standard.

This standard is part of the GenCAM 1.5 release.

> **"The data model of this standard shall be in effect until 2001-12."** At that time, the committee will consider changes, revision, other actions.

Users of this standard are encouraged to participate in the development of future revisions.

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Acknowledgment

Any Standard involving a complex technology draws material from a vast number of sources. While the principal members of the IPC Data Generation and Transfer Committee of the IPC Data Transfer Solution DTS Subcommittee are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

Data Generation and Transfer Committee

Chairman
Harry Parkinson
Digital Equipment

Data Transfer Solution DTS Subcommittee

Chairman
Harry Parkinson
Digital Equipment

Technical Liaisons of the IPC Board of Directors

Stan Plzak
Pensar Corp.

Peter Bigelow
Beaver Brook Circuits Inc.

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TABLE OF CONTENTS

Sectional Requirements for Implementation of Drawing Methods for Manufacturing Data Description (DRAWG)

1 SCOPE

This standard specifies data formats used to describe drawing methodologies for printed boards and printed board assemblies. These formats may be used for transmitting information between a printed board designer and a printed board manufacturer.

The information can be used for both manual and for digital interpretations. The data may be defined in either English or SI units.

1.1 Interpretation

"**Shall**", the emphatic form of the verb, is used throughout this standard whenever a requirement is intended to express a provision that is mandatory. Deviation from a **shall** requirement is not permitted, and compliance test modules (CTMs) developed to check syntax and semantics, will prompt the user to correct the ambiguity, or to insert missing information.

The words "should" and "may" are used whenever it is necessary to express non-mandatory provisions.

"Will" is used to express a declaration of purpose.

To assist the reader, the word **shall** is presented in bold characters.

1.2 Drawing Focus

The GenCAM format requirements are provided in a series of standards focused on printed board manufacturing, assembly, inspection, and testing. This standard, IPC-2513, provides information on drawing requirements and documentation methodology. The generic standard, IPC-2511 contains general requirements and is a mandatory part of the requirements of this standard, and provides general information necessary to completely understand the GenCAM structure.

2 APPLICABLE DOCUMENTS

The following documents contain provisions which, through reference in this text, constitutes provisions of IPC-2513. At the time of publication, the editions indicated were valid. All documents are subject to revision and parties to agreements based on this generic standard are encouraged to investigate the possibility of applying the most recent additions of the documents indicated below.

IPC-T-50		Terms and Definitions for Interconnecting and Packaging Electronic Circuits
IPC-2512	(ADMIN)	Sectional Requirements for Implementation of Administrative Methods for Manufacturing Data Description
IPC-2513	(DRAWG)	Sectional Requirements for Implementation of Drawing Methods for Manufacturing Data Description
IPC-2514	(BDFAB)	Sectional Requirements for Implementation of Printed Board Fabrication Data Description
IPC-2515	(BDTST)	Sectional Requirements for Implementation of Bare Board Product Electrical Testing Data Description

IPC-2516	(BDASM)	Sectional Requirements for Implementation of Assembled Board Product Manufacturing Data Description
IPC-2517	(ASEMT)	Sectional Requirements for Implementation of Assembly In-Circuit Testing Data Description
IPC-2518	(PTLST)	Sectional Requirements for Implementation of Part List Product Data Description
IPC-2519	(MODEL)	Sectional Requirements for Information Model Data Related to the Printed Board and Printed Board Manufacturing Descriptions

3 REQUIREMENTS

The requirements of IPC-2511 are a mandatory part of this standard. The IPC-2511 document describes the generic requirements of the GenCAM format. The format specifies details specifically for information interchange of data related to printed board manufacturing, assembly and test.

GenCAM is comprised of twenty sections as described in the generic GenCAM standard, IPC-2511. The sections are shown in Tables 3-1 and 3-2 of the IPC-2511.

Each section has a specific function or task respectively and is independent of each other. Accordingly, the information interchange for a specific purpose is possible only if the sections required for such a purpose have been prepared.

3.1 Categories and Content

Table 3-1 provides the section names that are appropriate for the printed board and printed board assembly drawing package. There are six major drawing functions that can be defined by the use of these files of the GenCAM system.

Table 3-1 indicates the requirements for various sections needed to describe each drawing procedure and process. The letter **"M"** signifies a *mandatory* requirement. The letter **"O"** signifies an *optional* characteristic that may or may not be pertinent to the particular file. A dash signifies an extraneous section (unnecessary); Compliance Test Modules (CTMs) will not reject file summaries if extraneous sections are present.

Table 3-1 signifies two requirement conditions separated by a "/". The first representation of requirements is intended to convey those GenCAM sections that **shall** be available as the initial input to the documentation processes. The second instance of a requirement is to signify those data that **shall** be available once the processing descriptions have been completed. The data may be added by the user, fabricator, assembly, or inspection/testing functions.

Table 3-1 GenCAM Section Relationships for Drawings

File Identifiers	Fabrication Drawing(s)	Assembly Drawing(s)	Schematic/ Logic Drawing(s)	Detail Drawing(s)	Parts List Drawing(s)	Specification/ Source Control Drawing(s)
HEADERS	M/M	M/M	M/M	M/M	M/M	M/M
ADMINISTRATION	M/M	M/M	M/M	M/M	M/M	M/M
PRIMITIVES	M/M	M/M	M/M	M/M	O/O	M/M
ARTWORKS	O/M	O/M	O/M	O/M	O/O	-/O
LAYERS	M/M	O/O	-/-	O/O	-/-	-/-
PADSTACKS	O/O	-/-	-/-	-/-	-/-	-/-
PATTERNS	O/O	O/O	O/O	O/O	-/-	-/-
PACKAGES	O/O	O/O	O/O	O/O	-/-	-/-
FAMILIES	-/-	-/-	-/-	-/-	-/-	-/-
DEVICES	-/-	O/O	M/M	-/-	O/O	-/-
MECHANICALS	O/O	O/O	-/-	M/M	O/O	O/O
COMPONENTS	M/M	M/M	M/M	-/-	M/M	-/-
ROUTES	O/O	-/-	-/-	-/-	-/-	-/-
POWER	-/-	-/-	O/O	-/-	-/-	-/O
TESTCONNECTS	-/-	-/-	-/-	-/-	-/-	-/-
BOARDS	M/M	M/M	-/-	O/O	O/O	-\-
PANELS	O/O	O/O	-/-	O/O	-/O	-\-
FIXTURES	O/O	O/O	-/-	-/O	-/O	-/O
DRAWINGS	O/M	O/M	O/M	O/M	O/M	O/M
CHANGES	-/ O*	-/O*	-/ O*	-/O*	-/O*	-/O*

* The CHANGES section is used independently to alter previously sent files. Included shall be a HEADER section (for revision status and identification) and an ADMINISTRATION section to show effectivity.

The correlation between the various descriptions identified in this standard is indicated in Figure 3-1. This shows the relationship of drawing files.

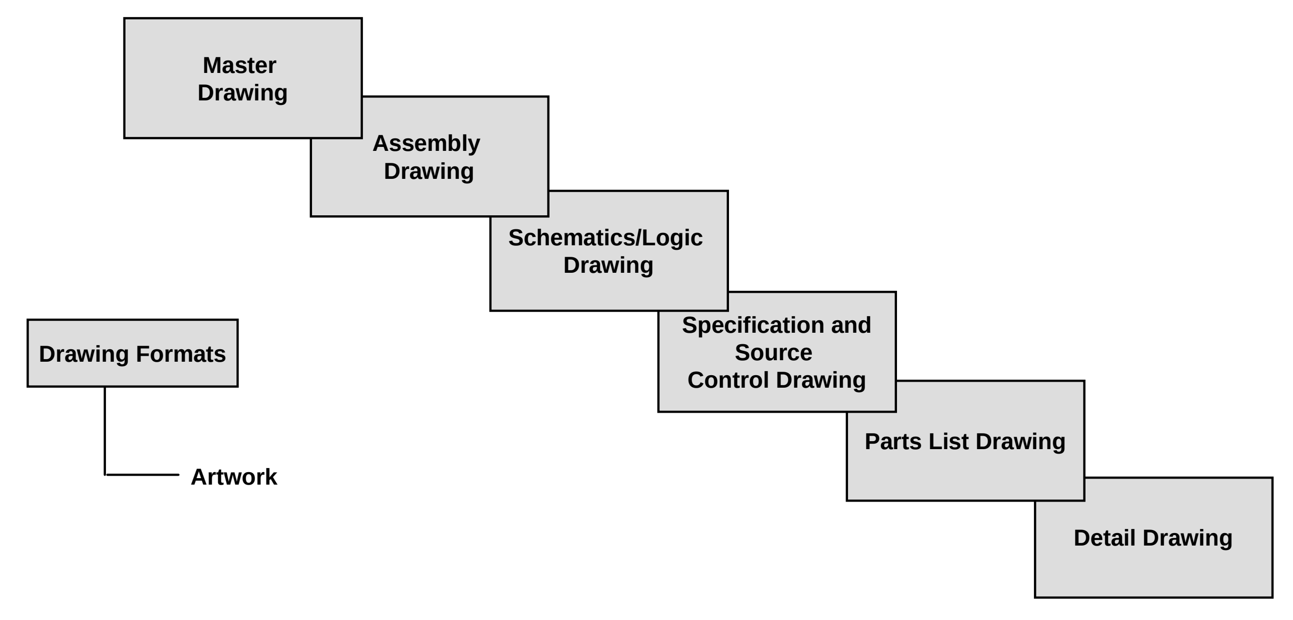


Figure 3-2 Drawing Types

4 GENERAL RULES

The following details reflect the rules used in GenCAM to meet the requirements for drawing data. These rules are intended to meet the needs of the manufacturer to understand the customer requirements.

Wherever necessary, additional requirements have been detailed to reflect precision. The attributes and rules for GenCAM described in IPC-2511 are required.

Wherever necessary, detailed descriptions or definitions of the entities, attributes or characteristics are described according to the following issues detailed in Table 4-1 and 4-2 and descriptions.

Table 4-1 Keyword Usage

Needs Identifier	Keyword/Section	Keyword Usage
Type of drawing	DWGTYPE	One of six drawing types - FABRICATION, ASSEMBLY, SCHEMATIC, DETAIL, PARTS LIST are fixed field parameters.
Size of drawing	DWGSIZE	One of ten drawing sizes - A, A0, A1, A2, A3, A4, B, C, D, and E are fixed field parameters
Revision of drawing	DWGREV	Document revision
Drawing number	DWGNUMBER	Document number
Drawing date	DWGDATE	Date of document: YYYY-MM-DD
Drawing name	DWGNAME	Name of drawing
External Reference	DWGREF	Location of drawing, format of drawing

Table 4-2 DRAWING Keyword Parameter Usage

Needs Identifier	Parameter	Parameter Value	Parameter Usage
Fabrication Drawing Set	<drawing_type>	FABRICATION	Board fabrication drawings
Assembly Drawing Set	<drawing_type>	ASSEMBLY	Board assembly drawings
Schematic Drawing Set	<drawing_type>	SCHEMATIC	Schematic drawings
Detail Drawing Set	<drawing_type>	DETAIL	Detail drawings
Specifications	<drawing_type>	SPECIFICATION	Specification
Part	<drawing_type>	SPECIFICATION	Specification
Performance	<drawing_type>	SPECIFICATION	Specification
Acceptance	<drawing_type>	SPECIFICATION	Specification
Board Test Specification	<drawing_type>	BOARDTEST	Board test requirements
Assembly Test Specification	<drawing_type>	ASSEMBLYTEST	Assembly test requirements
Machine Fixture	<drawing_type>	MACHINE	Fixture configuration drawings
Phototool Drawing Set	<drawing_type>	PHOTOTOOL	Graphical representation of photoplots
Combination Drawings	<drawing_type>	COMBINATION	Combination of drawing types
Parts list	<drawing_type>	PARTSLIST	Parts list drawings

4.1 DRAWINGS

DRAWINGS may be in a variety of types, formats, and sizes. DRAWINGS formats in GenCAM format use primitives, artwork and other details contained in GenCAM related sections.

DRAWINGS may include board fabrication drawings, assembly drawings, schematics, detail drawings, parts lists, and specifications. Note that parts lists and schematic drawings are not necessarily intelligent electronic data bases, but are graphical representation of the schematic or parts list. However, linkages between the symbol (ARTWORKS section) and COMPONENTS

section can provide the details necessary to add intelligence to the schematic or parts list information (see IPC-2518).

4.2 DWGTYPE Parameters

The DRAWINGS section is used to identify and describe the drawing set associated with the assembly as shown in Table 4-2. All drawings that are included in the GenCAM file shall be described in the GenCAM language. Drawings in other formats can be referenced as a parameter to the DWGREF statement.

5 MODELING

The data files of GenCAM may be mapped to the information models. Information models are in development to ensure that complete mapping is capable between the information provided within GenCAM characteristics. The correlation is provided in the activity models shown in IPC-2519.

All data of GenCAM activities are based on activity models. The activity models covered by CAD and CAM include the engineering, design, administrative, and fabrication and assembly characteristics. Each of these sections are intended to be detailed into various levels of activity much like layers of information needed to perform a particular manufacturing process.

Figure 5-1 shows the activity needed to develop administrative data.

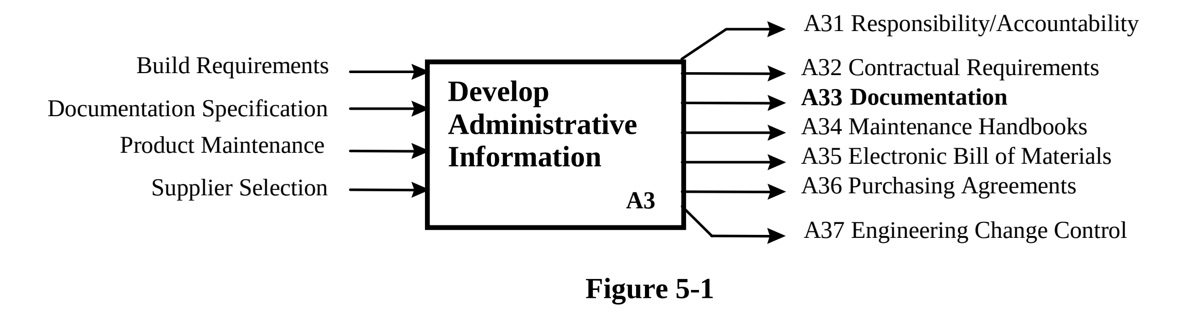


Figure 5-1

5.1 Information Models

Information models are also helpful in understanding the requirements of the DRAWINGS section. Information Models

Information models are also helpful in understanding the requirements of the DRAWINGS section. Attribute information is correlated to the parameters of GenCAM as well as to the activity models used to describe documentation and drawing data.

EXPRESS is an international information modeling format supported by ISO 10303-11. The graphic representation of EXPRESS is known as EXPRESS-G. Appendix A provides an explanation of the different EXPRESS-G requirements. Figures 5-2 through 5-10 show the EXPRESS-G version of the GenCAM DRAWINGS section. See www.gencam.org for the complete EXPRESS-G model.

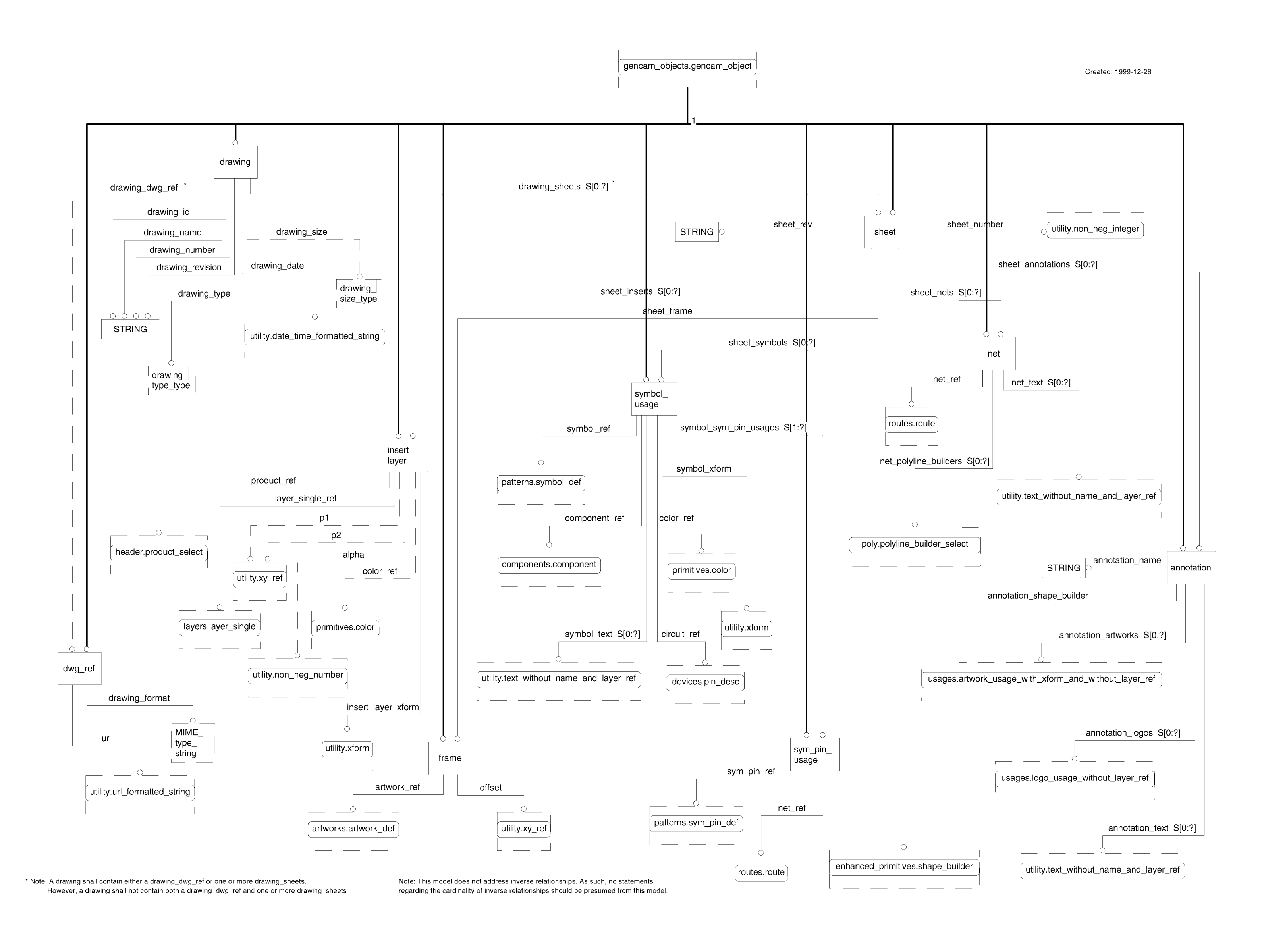


Figure 5-2 EXPRESS-G for DRAWINGS

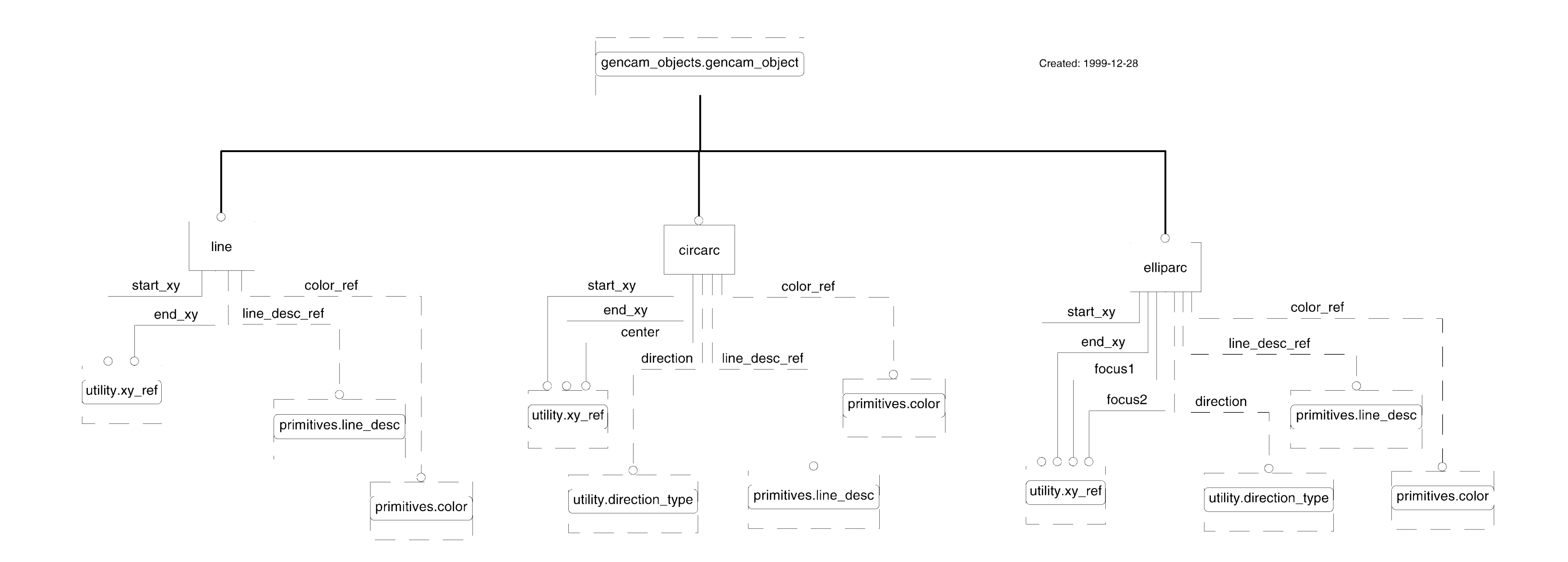


Figure 5-3 EXPRESS-G for Graphic PRIMITIVES

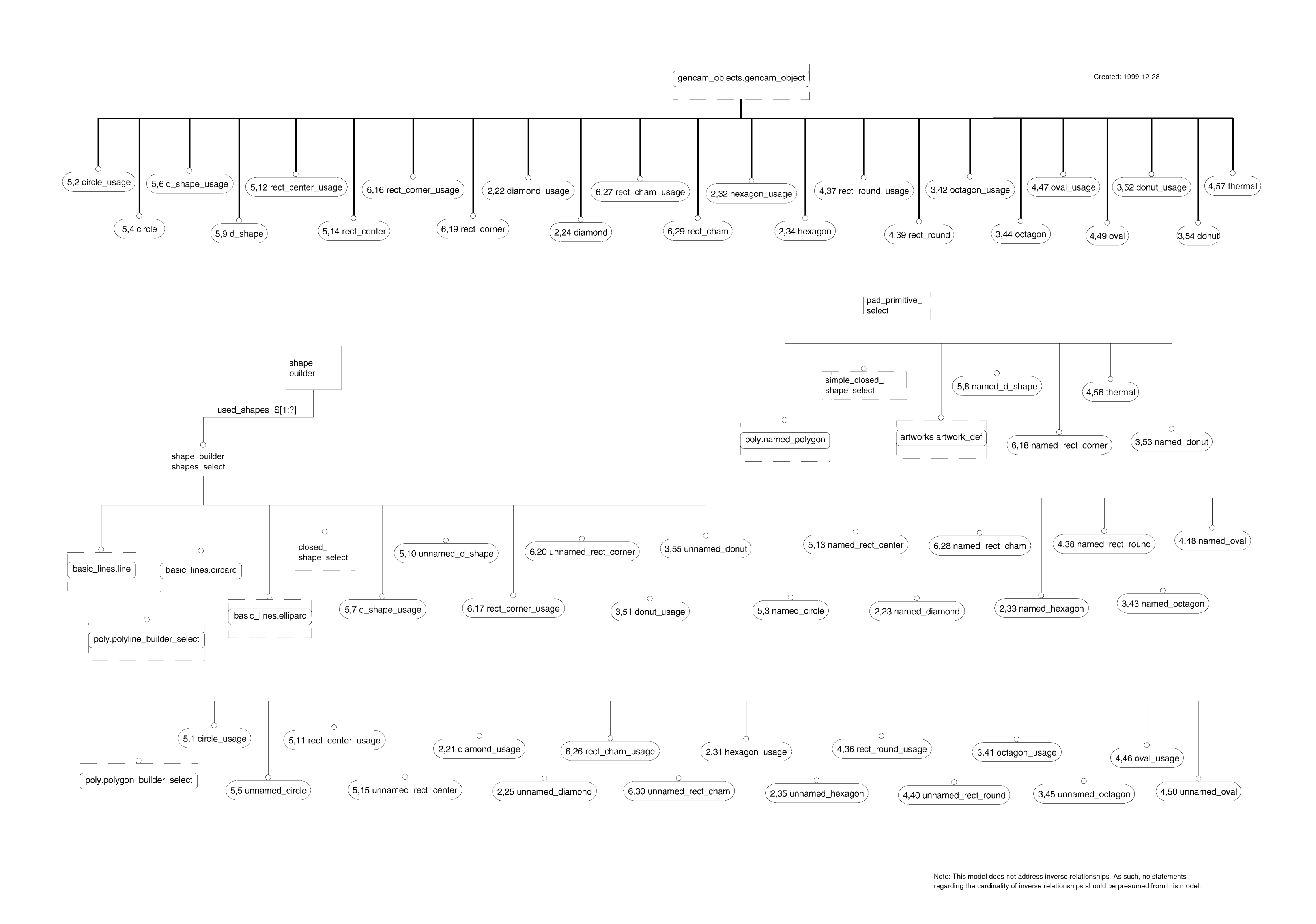


Figure 5-4 EXPRESS-G for PRIMITIVES

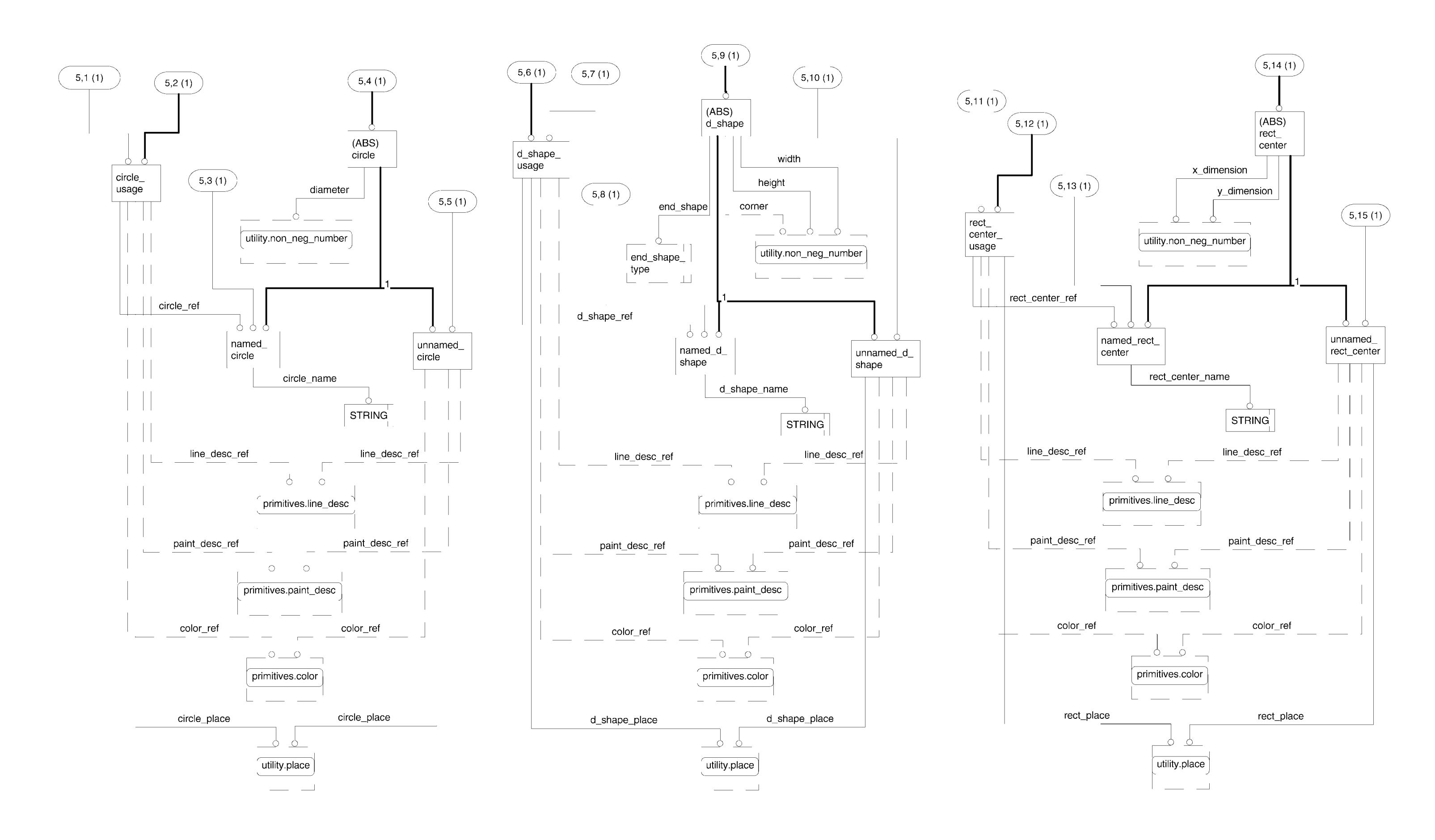


Figure 5-5 EXPRESS-G for Basic PRIMITIVES

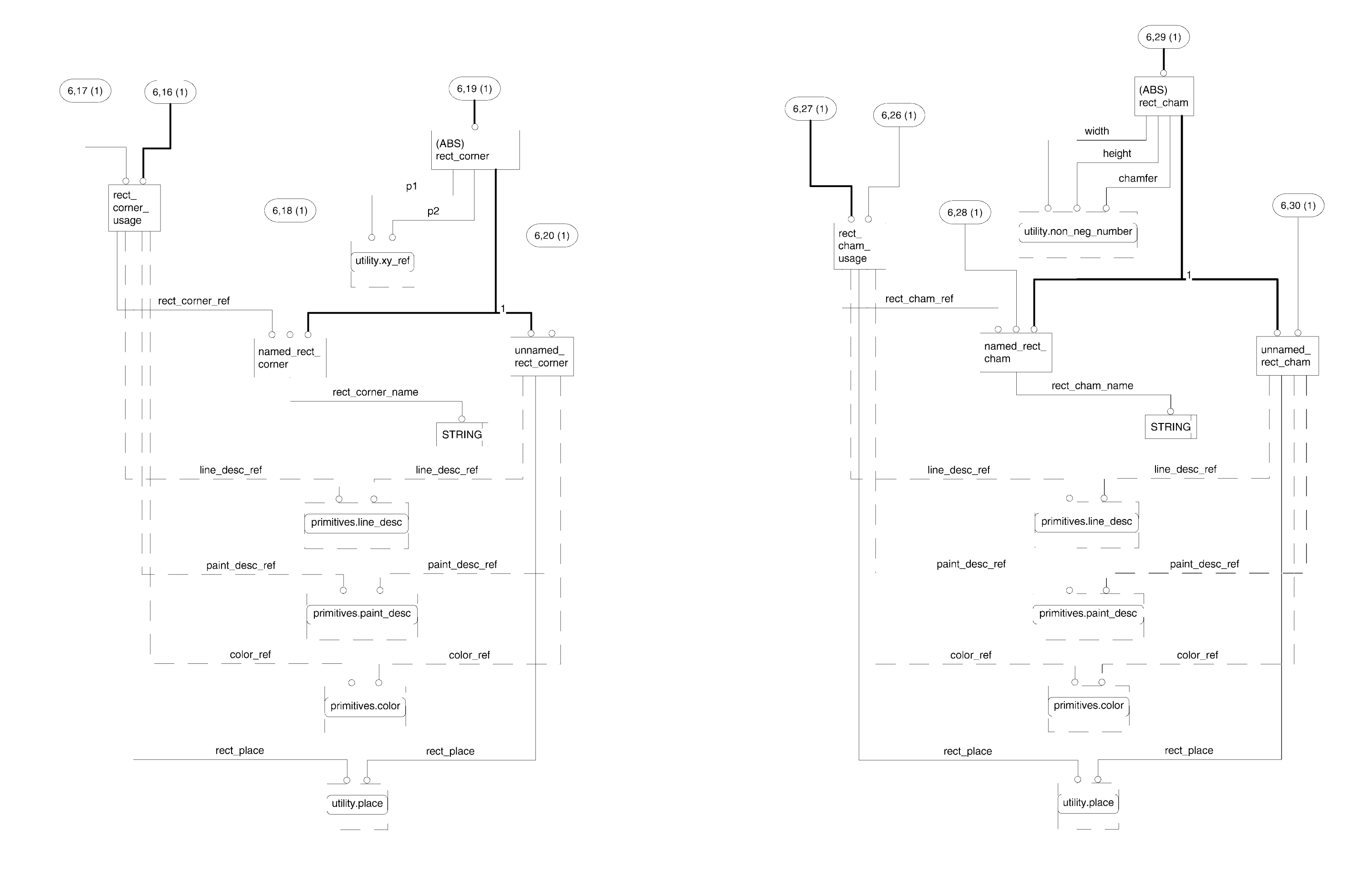


Figure 5-6 EXPRESS-G for Rectangle Usage

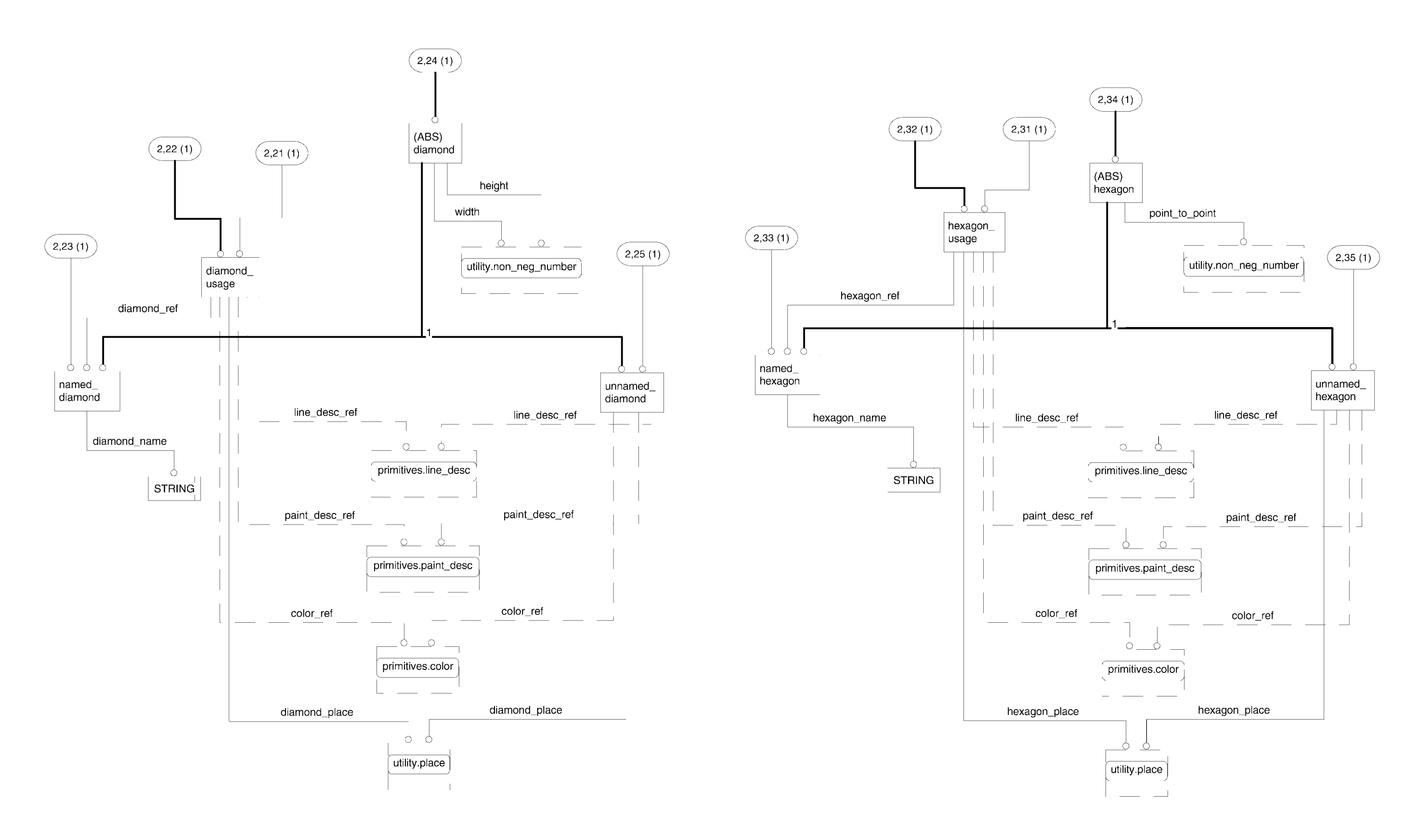


Figure 5-7 EXPRESS-G for Diamond/Hexagon Usage

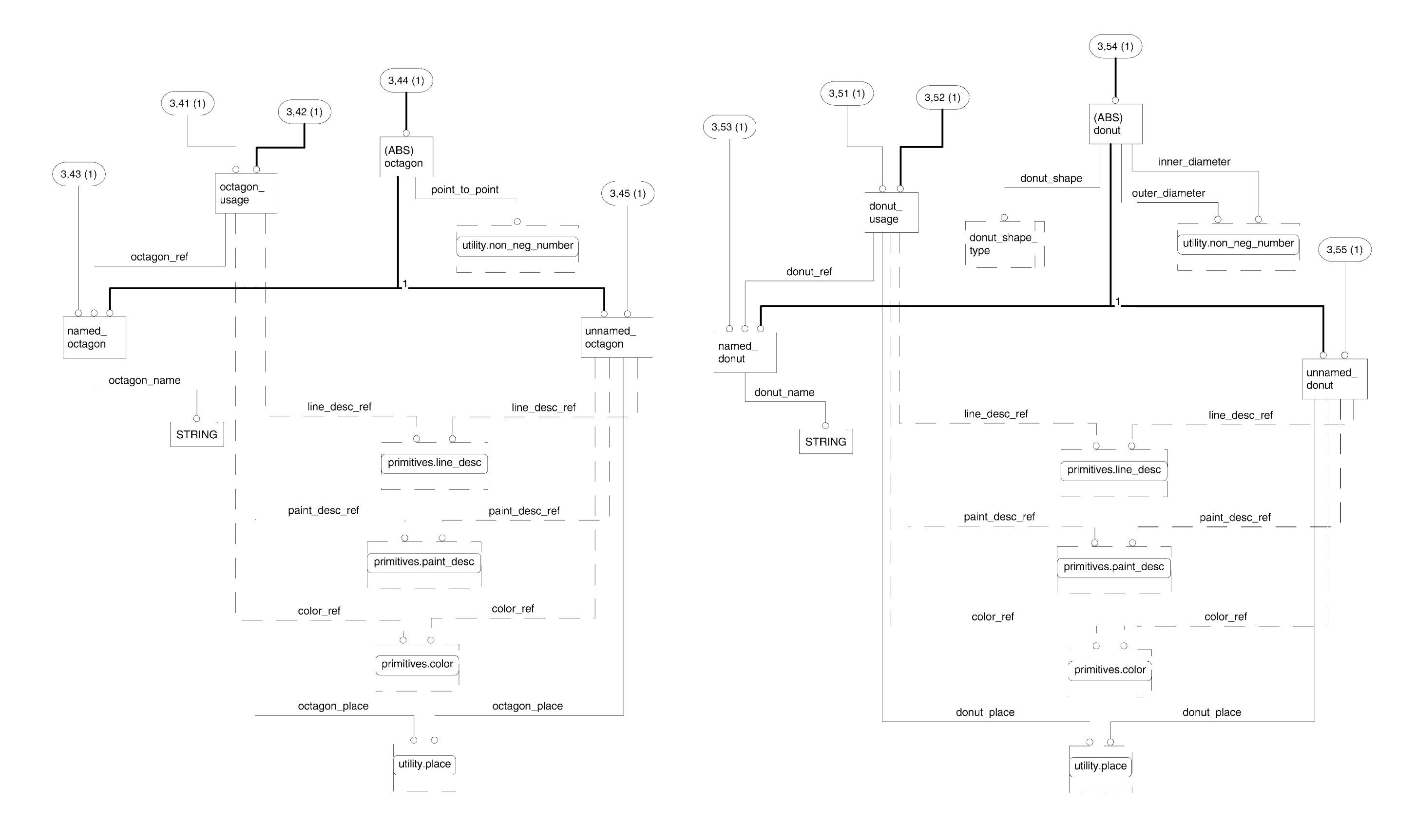


Figure 5-8 EXPRESS-G for Octagon/Donut Usage

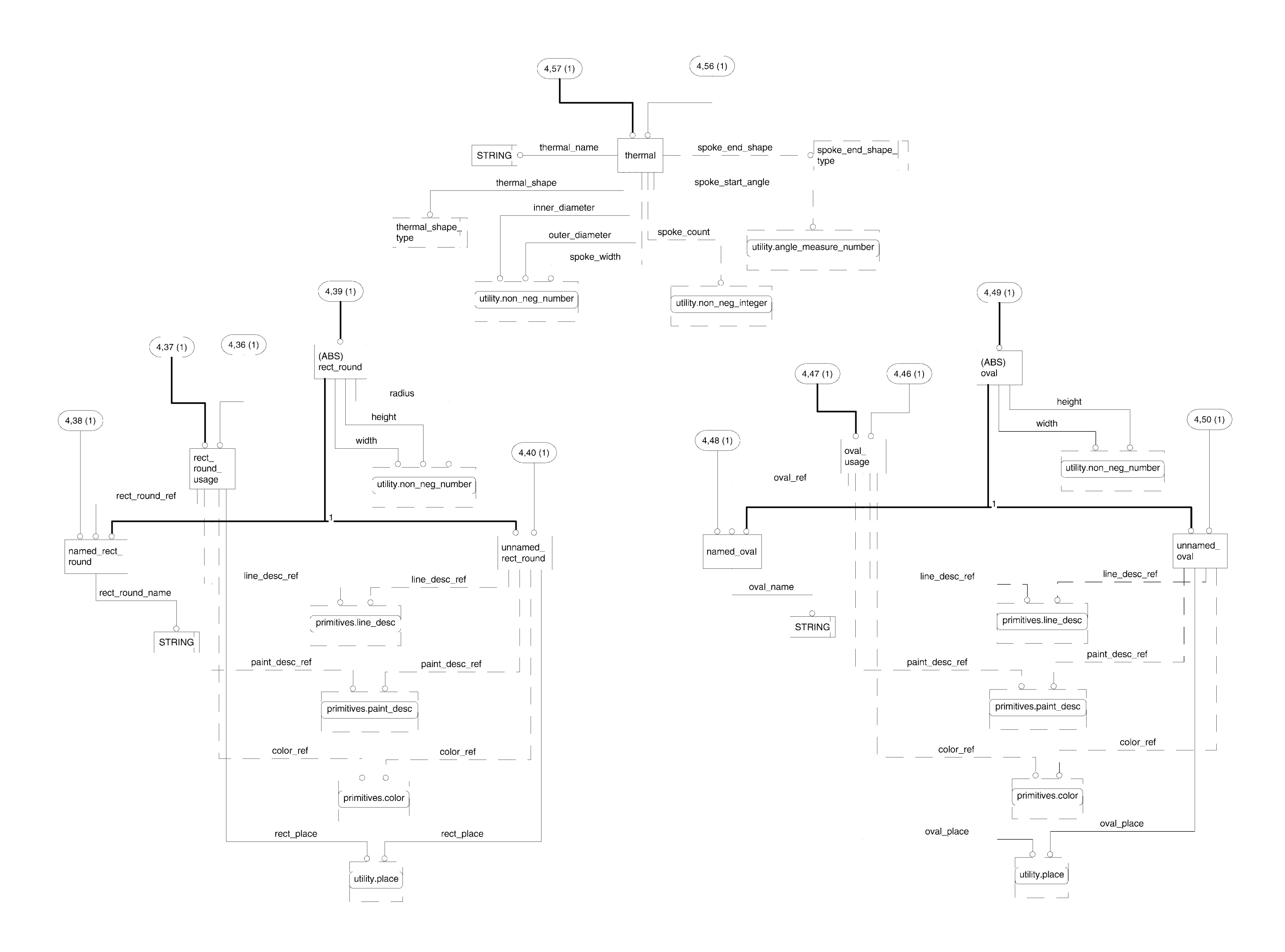


Figure 5-9 EXPRESS-G for Oval/Rectangle/Thermal Usage

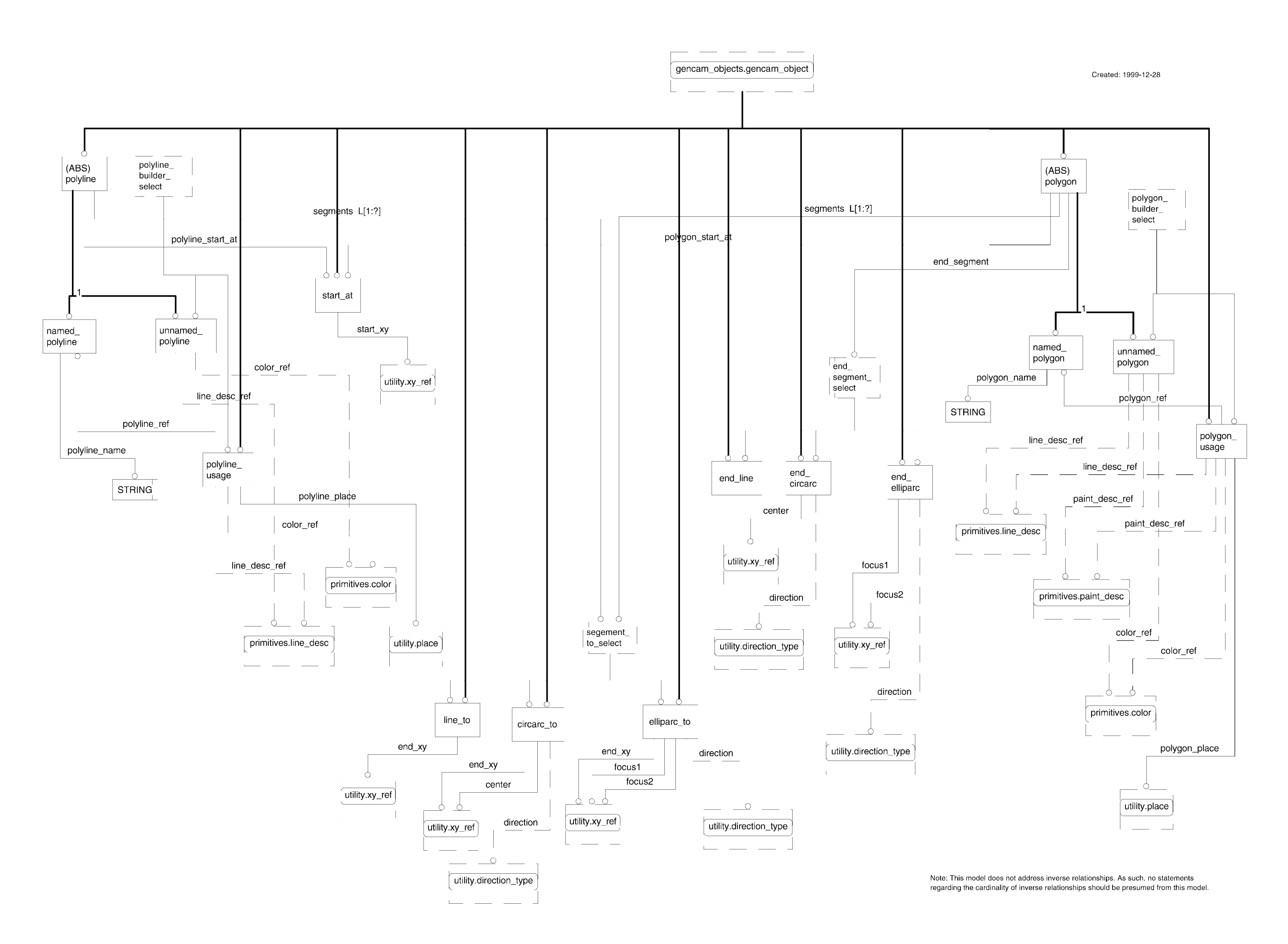


Figure 5-10 EXPRESS-G for Poly Descriptions

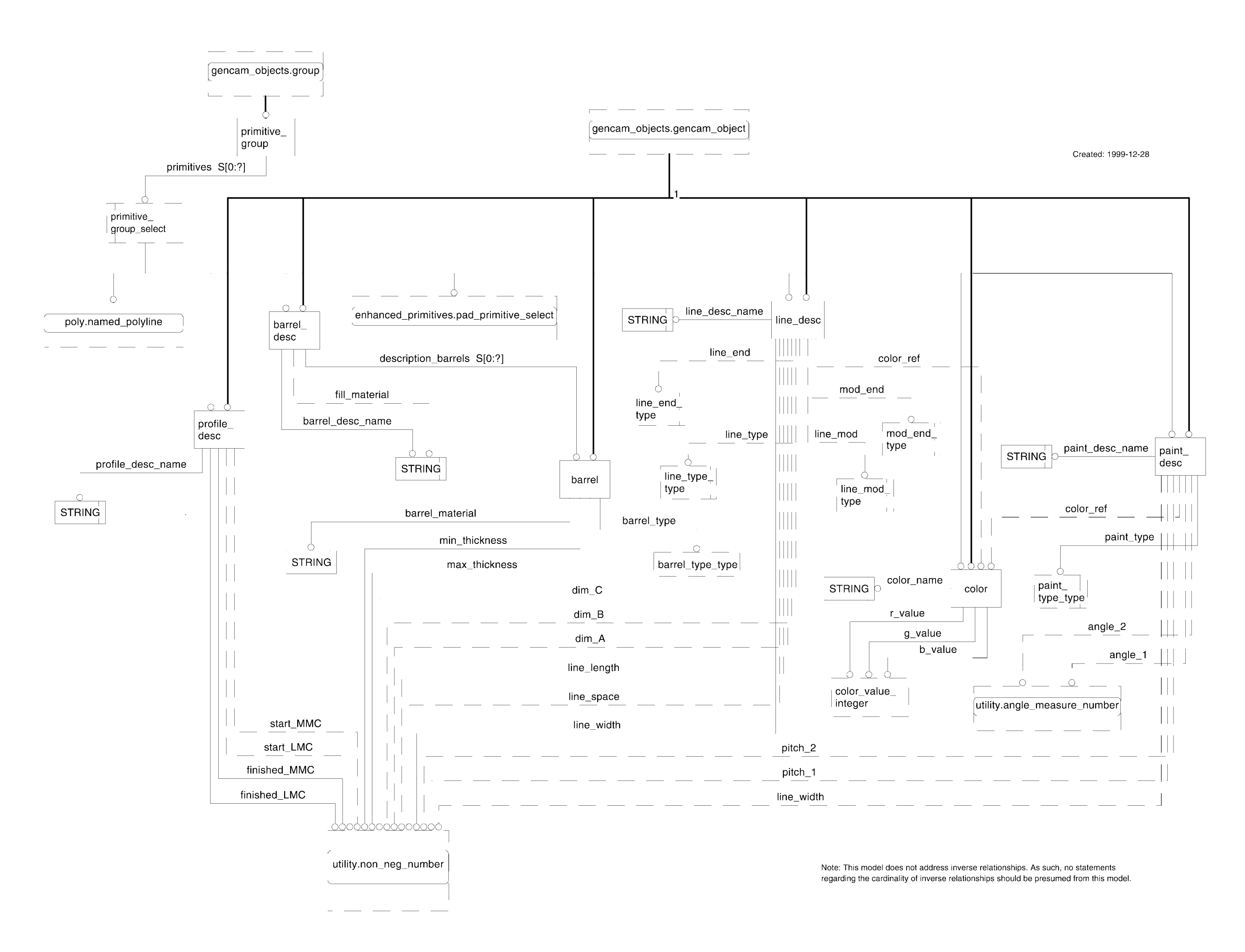


Figure 5-11 EXPRESS-G for Primitive Enhancements

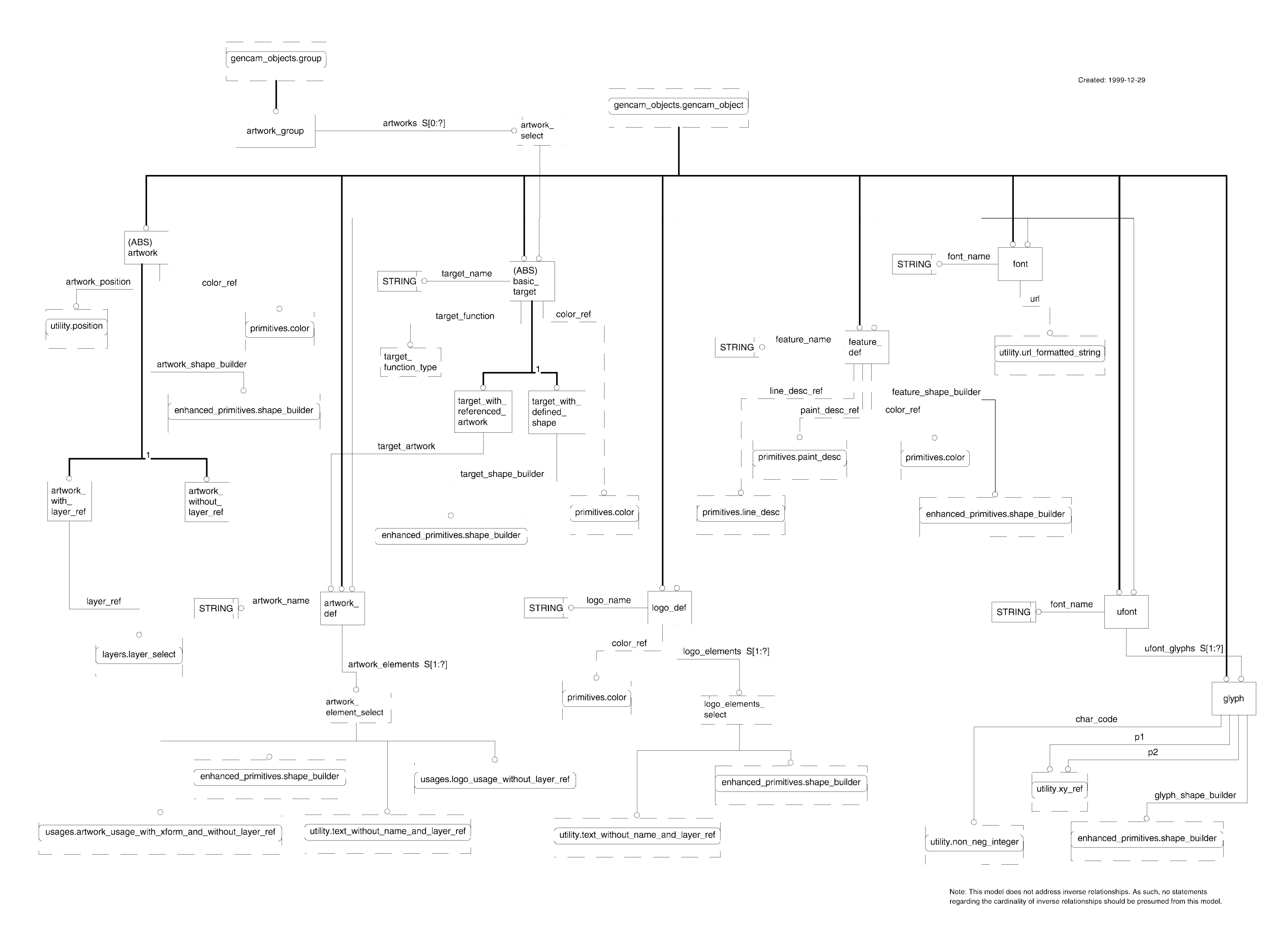


Figure 5-12 EXPRESS-G for ARTWORKS

6 REPORT GENERATORS

Report Generators Data can be extracted from GenCAM files to produce various formats that are commonly used in the electronics industry. The types of reformatting can be used for electronic data transfer to tools or to facilitate inspection and human interpretation of text and/or graphic rendering. Note that no extraction tools are included in the IPC-2510 standard. Their creation is left to the industry as the need arises. For instance, the report generators for drawings may be DXF, Postscript®, EPS, Gerber, HPGL or other formats. The resultant hard copy should look similar to the examples in Figures 6-1 and 6-2.

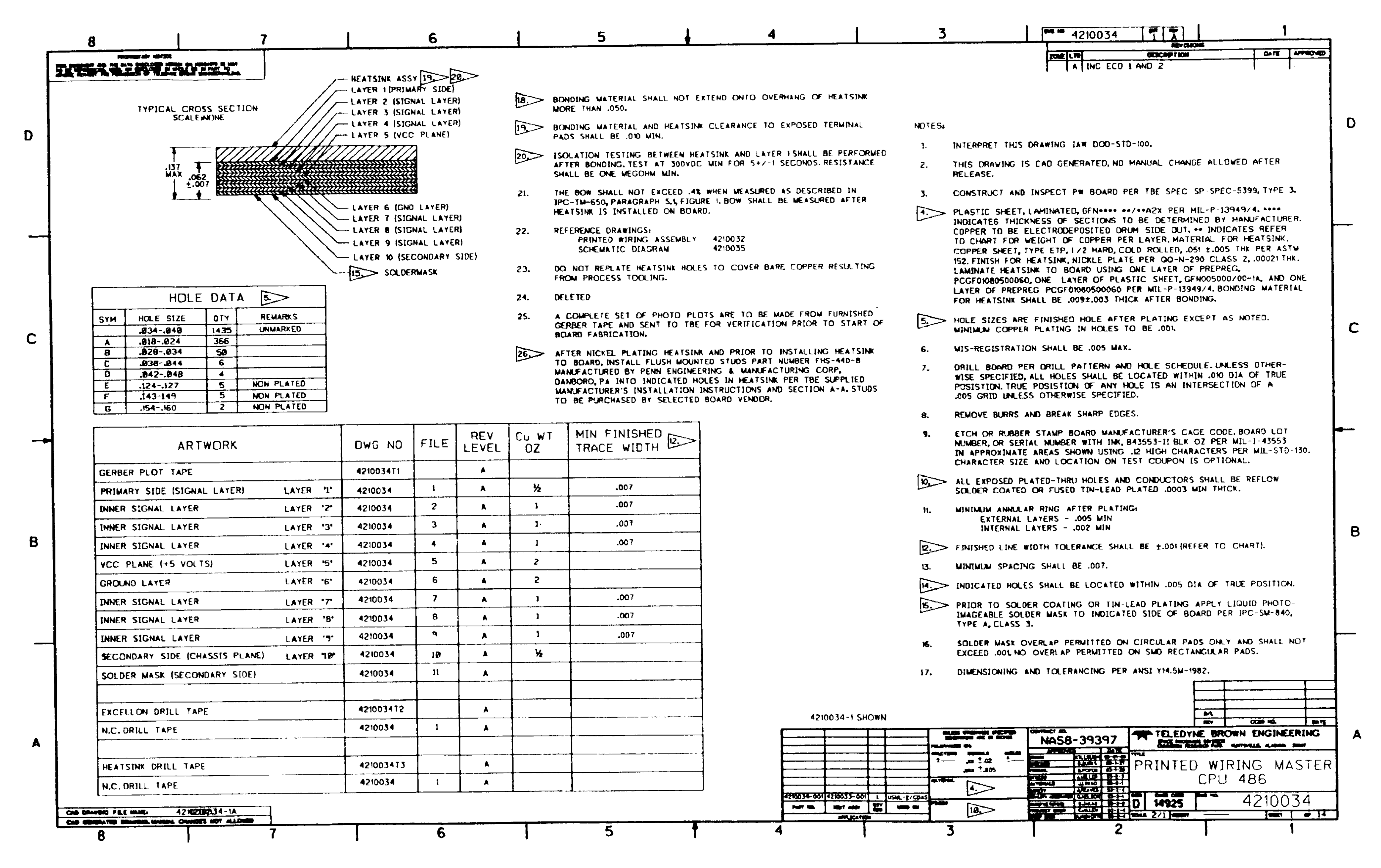


Figure 6-1 Fabrication Drawing

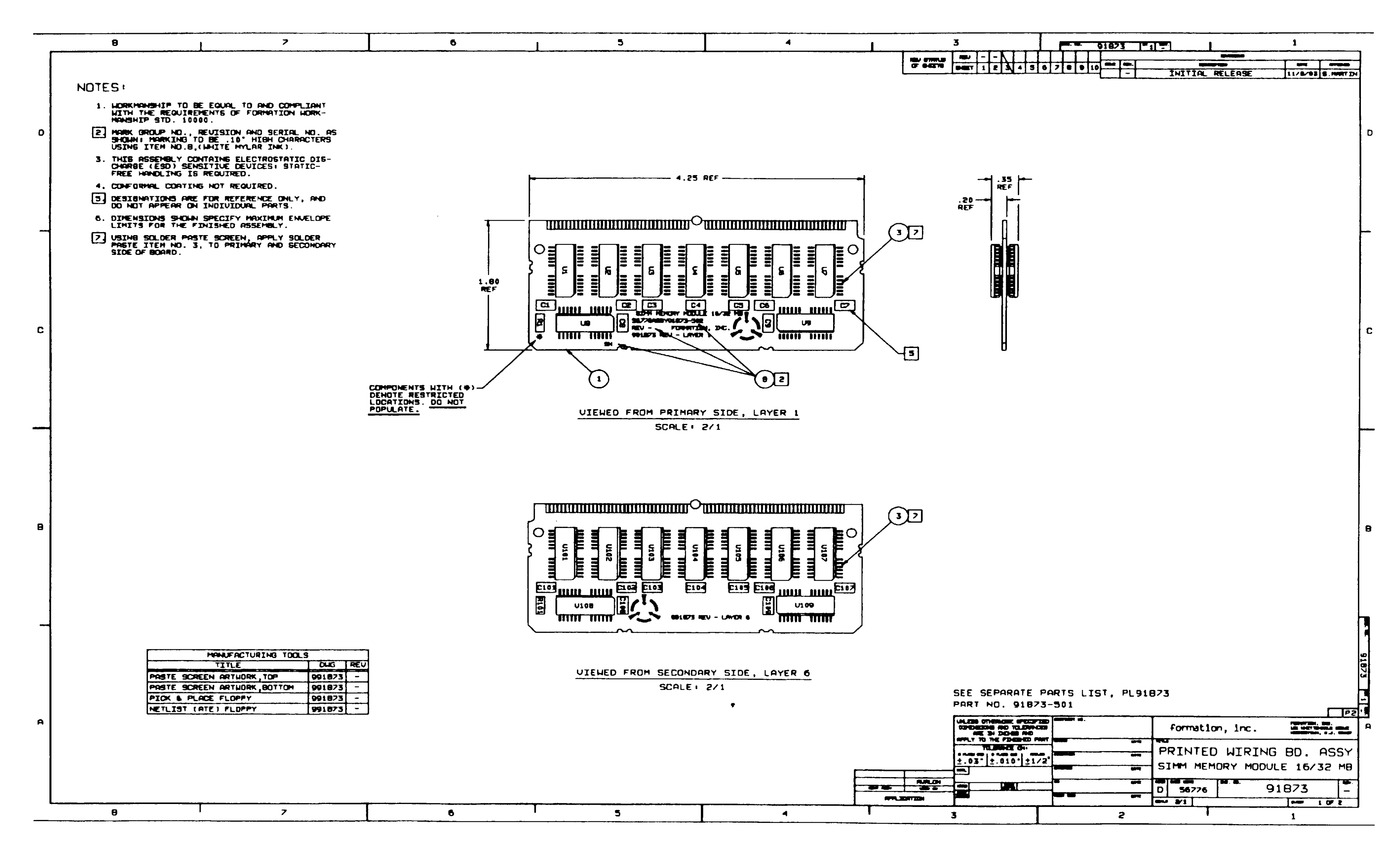


Figure 6-2 Assembly Drawing

7 REFERENCE INFORMATION

The following sections define reference documents that are useful in clarifying the products or process of the industry or provide additional insight into the subject of data modeling or released information models.

7.1 IPC (1)

IPC-2221 Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies
IPC-D-300 Printed Board Dimensions and Tolerances
IPC-D-310 Guidelines for Artwork Generation and Measurement Techniques for Printed Circuits
IPC-D-325 Documentation Requirements for Printed Boards, Assemblies and Support Drawings

7.2 American National Standards Institute (2)

ANSI X3/TR-1-77 American National Dictionary for Information Processing
ANSI X3.12 Subroutine Record Format Standardization
ANSI Y14.5 Dimensioning and Tolerancing for Engineering Drawing
ANSI Y32.1 Logic Diagram Standards
ANSI Y32.16 Electrical and Electrical Reference Designators
ANSI Z210.1 Metric Practice Guide (ASTM 380-72)

7.3 Department of Defense (3)

DoD-STD-100 Engineering Drawings

7.4 Electronic Industries Association (4)

EDIF 4 0 0 Electronic Data Interchange Format

7.5 International Organization for Standards (ISO)

ISO STEP Documentation
AP210 Electronic Printed Circuit Assembly: Drawings and Manufacturing
AP211 Electronic PC Assembly, Test Diagnostics & Remanufacture
AP221 Process Plant Functional Data & Schematic Representation

Appendix A

EXPRESS defines data objects and their relationships among data objects for a domain of interests. Some typical applications of data models include supporting the development of databases and enabling the exchange of data for a particular area of interest. As an example, a specific requirement of a database for an audio compact disc (CD) collection is shown in Figure 1.

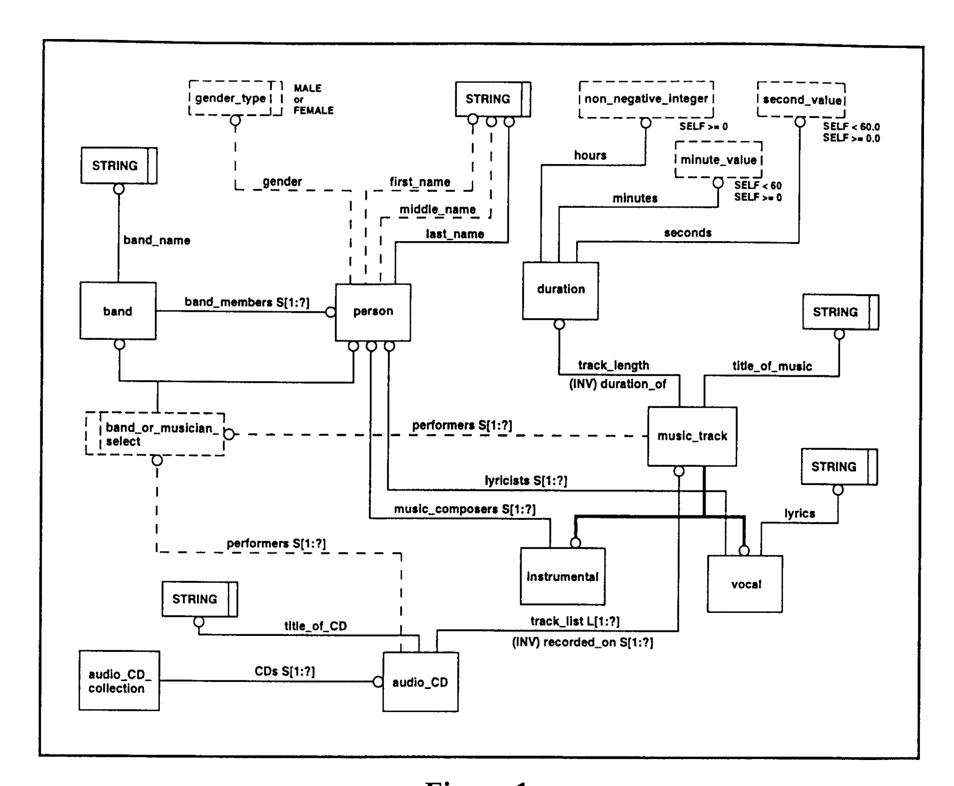


Figure 1

Data models are specified in a data modeling language. EXPRESS is a data modeling language defined in ISO 10303-11. One of the advantages of using EXPRESS-G over EXPRESS is that the structure of a data model can be more intuitively presented. A disadvantage of EXPRESS-G is that complex constraints cannot be formally specified. There are specific symbols used in EXPRESS-G notation. The meaning of those symbols is defined in the EXPRESS formatting.